

Applicant: Wasserscheid et al.  
Filing Date: March 11, 2004

Amendments to the Claims

Docket No. VSKW-1

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## Claims

We claim the following:

1) (Canceled)

1 ~~2~~ (Currently Amended) ~~The method of claim 1~~ A method of using a compound of the Formula  
5 1 in a process,

(cation)(R'SO<sub>4</sub>)

Formula 1

comprising the step of: employing the compound as a solvent, solvent additive, or  
extraction solvent; or employing the compound as a heat carrier, or heat carrier additive,  
10 wherein:

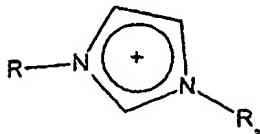
R' is selected from the group consisting of a linear or branched, saturated or unsaturated,  
aliphatic or alicyclic, functionalized or non-functionalized alkyl radical with 3-36 carbon atoms,  
wherein R' is optionally functionalized with one or more X groups; X is selected from the group  
consisting of an -OH, -OR'', -COOH, -COOR'', -NH<sub>2</sub>, -SO<sub>3</sub>, -F, -Cl, -Br, -I or -CN; and R'' is  
15 selected from the group consisting of a branched or linear hydrocarbon chain with 1 - 12 carbon  
atoms;

the compound has a melting point of less than 100° C; and

wherein the cation is a nitrogen-containing cation selected from the group consisting of a  
quaternary ammonium cation, an imidazolium cation, a pyridinium cation, a pyrazolium cation, a  
20 phosphonium and a triazolium cation.

2 ~~3~~ (Currently Amended) ~~The method of claim 1~~, wherein the cation is selected from the group  
consisting of:

- a) quaternary ammonium cation with the general formula (NR<sub>1</sub>R<sub>2</sub>R<sub>3</sub>R)<sup>+</sup>;
- b) phosphonium cation with the general formula (PR<sub>1</sub>R<sub>2</sub>R<sub>3</sub>R)<sup>+</sup>;
- 25 c) imidazolium cation with the general formula



in which the imidazole core is optionally substituted with at least one group selected from  
C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-  
aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group;

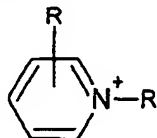
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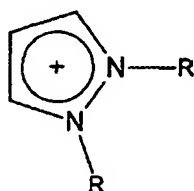
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d) pyridinium cation with the general formula



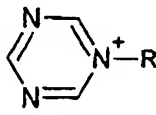
in which the pyridine core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-  
5 aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group;

e) pyrazolium cation with the general formula



in which the pyrazole core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-  
10 aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group; and

f) triazolium cation with the general formula



in which the triazole core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-  
15 aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group; wherein

g) the radicals R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup> are selected independently at each occurrence from the group consisting of:

- i) hydrogen;
- ii) linear or branched, saturated or unsaturated, aliphatic or alicyclic alkyl groups with 1  
20 to 20 carbon atoms;
- iii) heteroaryl groups, heteroaryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 3 to 8 carbon atoms in the heteroaryl radical and at least one heteroatom selected from N, O and S which is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl groups and/or

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halogen atoms;

iv) aryl, aryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 5 to 12 carbon atoms in the aryl radical, which is optionally substituted with at least one C<sub>1</sub>-C<sub>6</sub> alkyl group and/or a halogen atom; and

h) the radical R is selected from the group consisting of:

5 i) linear or branched, saturated or unsaturated, aliphatic or alicyclic alkyl groups with 1 to 20 carbon atoms;

ii) heteroaryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 3 to 8 carbon atoms in the aryl radical and at least one heteroatom selected from N, O and S, which is optionally substituted with at least one C<sub>1</sub>-C<sub>6</sub> alkyl group and/or halogen atom; and

10 iii) aryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 5 to 12 carbon atoms in the aryl radical, which is optionally substituted with at least one C<sub>1</sub>-C<sub>6</sub> alkyl group and/or halogen atom.

3-4) (Currently Amended) The method of claim <sup>1</sup>~~4~~, wherein the anion has an empirical formula selected from the group consisting of C<sub>4</sub>H<sub>9</sub>SO<sub>4</sub>, C<sub>8</sub>H<sub>17</sub>SO<sub>4</sub> or C<sub>12</sub>H<sub>25</sub>SO<sub>4</sub>.

4-5) (Currently Amended) The method of claim <sup>1</sup>~~4~~, wherein the compound of the Formula 1 has a melting point of less than 75° C.

5-6) (Currently Amended) The method of claim <sup>1</sup>~~4~~, wherein the compound of the Formula 1 has a melting point of less than 50° C.

6-7) (Currently Amended) The method of claim <sup>1</sup>~~4~~, wherein (R'SO<sub>4</sub>) is an alkyl sulfate ester, wherein the alkyl moiety is selected from the group consisting of butyl, octyl, 2-ethylhexyl, and dodecyl; and the method comprises the step of: employing the compound as a solvent, solvent additive, or extraction solvent; or employing the compound as a heat carrier, or heat carrier additive; or employing the compound as a phase transfer catalyst.

7-8) (Previously Amended) The method of claim <sup>6</sup>~~7~~, wherein the cation is a nitrogen containing cation selected from the group consisting of 1-ethyl-3-methylimidazolium, 1-butyl-3-methylimidazolium butyl, 1-hexyl-3-methylimidazolium, 1-octyl-3-methylimidazolium, 1-decyl-3-methylimidazolium, 1-dodecyl-3-methylimidazolium, 1-butyl-pyridinium, trimethyldecylammonium, trioctylmethylammonium, trimethyldecylammonium, and trihexyltetradecylphosphonium.

8-9) (Currently Amended) The method of claim <sup>1</sup>~~7~~, wherein the cation is a nitrogen containing cation selected from the group consisting of 1-ethyl-3-methylimidazolium, 1-butyl-3-methylimidazolium butyl, 1-hexyl-3-methylimidazolium, 1-octyl-3-methylimidazolium, 1-

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decyl-3-methylimidazolium, 1-dodecyl-3-methylimidazolium, 1-butyl-pyridinium, trimethyldecylammonium, trioctylmethylammonium, trimethyldecylammonium, and trihexyltetradecylphosphonium; and the method comprises the step of: employing the compound as a solvent, solvent additive, or extraction solvent; or employing the compound as a heat carrier, or heat carrier additive; or employing the compound as a phase transfer catalyst.

9 10) (Currently Amended) The method of claim <sup>1</sup>~~12~~, wherein the compound of the Formula 1 is used in a reaction catalyzed by a transition metal; and the method comprises the step of: employing the compound as a solvent, solvent additive, or extraction solvent; or employing the compound as a heat carrier, or heat carrier additive; or employing the compound as a phase transfer catalyst.

10 11) (Previously Amended) The method of claim <sup>9</sup>~~10~~, wherein the compound of the Formula 1 is used in a hydroformylation reaction, oligomerization reaction, esterification reaction, isomerization reaction or amide bond-forming reaction.

15 12) (Currently Amended) The method of claim <sup>1</sup>~~12~~, wherein the compound of the Formula 1 is used in a reaction catalyzed by an enzyme or biocatalyst; and the method comprises the step of: employing the compound as a solvent, solvent additive, or extraction solvent; or employing the compound as a heat carrier, or heat carrier additive; or employing the compound as a phase transfer catalyst.

20 12 13) (Previously Amended) The method of claim <sup>11</sup>~~12~~, wherein the compound of the Formula 1 is used in an oligomerization reaction, C-C bond-forming reaction, esterification reaction, isomerization reaction, or amide bond-forming reaction.

13 14) (Currently Amended) The method of claim <sup>1</sup>~~12~~, wherein the compound of the Formula 1 is substantially hydrolytically stable in neutral aqueous solution (pH = 7) up to 80° C.

25 14 15) (Currently Amended) The method of claim <sup>1</sup>~~12~~, wherein the compound of the Formula 1 has a melting point of less than 25° C.

15 16) (Currently Amended) The method of claim <sup>1</sup>~~12~~, wherein the compound is selected from the group consisting of:

- a) 1-ethyl-3-methylimidazolium butyl sulfate;
- 30 b) 1-ethyl-3-methylimidazolium octyl sulfate;
- c) 1-ethyl-3-methylimidazolium 2-ethylhexyl sulfate;

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- d) 1-ethyl-3-methylimidazolium dodecyl sulfate;
- e) 1-butyl-3-methylimidazolium butyl sulfate;
- f) 1-butyl-3-methylimidazolium octyl sulfate;
- g) 1-butyl-3-methylimidazolium 2-ethylhexyl sulfate;
- 5 h) 1-butyl-3-methylimidazolium dodecyl sulfate;
- i) 1-hexyl-3-methylimidazolium butyl sulfate;
- j) 1-hexyl-3-methylimidazolium octyl sulfate;
- k) 1-hexyl-3-methylimidazolium 2-ethylhexyl sulfate;
- l) 1-hexyl-3-methylimidazolium dodecyl sulfate;
- 10 m) 1-octyl-3-methylimidazolium butyl sulfate;
- n) 1-octyl-3-methylimidazolium octyl sulfate;
- o) 1-octyl-3-methylimidazolium 2-ethylhexyl sulfate;
- p) 1-octyl-3-methylimidazolium dodecyl sulfate;
- q) 1-decyl-3-methylimidazolium butyl sulfate;
- 15 r) 1-decyl-3-methylimidazolium octyl sulfate;
- s) 1-decyl-3-methylimidazolium 2-ethylhexyl sulfate;
- t) 1-decyl-3-methylimidazolium dodecyl sulfate;
- u) 1-dodecyl-3-methylimidazolium butyl sulfate;
- v) 1-dodecyl-3-methylimidazolium octyl sulfate;
- 20 w) 1-dodecyl-3-methylimidazolium 2-ethylhexyl sulfate;
- x) 1-dodecyl-3-methylimidazolium dodecyl sulfate;
- y) 1-butyl-pyridinium butyl sulfate;
- z) 1-butyl-pyridinium octyl sulfate;
- aa) 1-butyl-pyridinium 2-ethylhexyl sulfate;
- 25 bb) 1-butyl-pyridinium dodecyl sulfate;
- cc) trimethyldecylammonium butyl sulfate;
- dd) trimethyldecylammonium 2-ethylhexyl sulfate;
- ee) trioctylmethylammonium butyl sulfate;
- ff) trioctylmethylammonium octyl sulfate;
- 30 gg) trioctylmethylammonium 2-ethylhexyl sulfate;
- hh) trioctylmethylammonium dodecyl sulfate;

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- ii) trimethyldecylammonium butyl sulfate;  
jj) trimethyldecylammonium octyl sulfate;  
kk) trihexyltetradecylphosphonium butyl sulfate;  
ll) trihexyltetradecylphosphonium octyl sulfate;  
5 mm) trihexyltetradecylphosphonium 2-ethylhexyl sulfate;  
nn) trihexyltetradecylphosphonium dodecyl sulfate; and the method comprises the step of:  
employing the compound as a solvent, solvent additive, or extraction solvent; or  
employing the compound as a heat carrier, or heat carrier additive; or employing the  
compound as a phase transfer catalyst.

10 <sup>16</sup> 17) (Previously Amended) A method of using a compound of the Formula 1 in a process

(cation)(R'SO<sub>4</sub>)  
Formula 1

comprising the step of: employing the compound as a solvent, solvent additive, or  
extraction solvent; or employing the compound as a heat carrier, or heat carrier additive,  
15 wherein:

R' is selected from the group consisting of a linear or branched, saturated or unsaturated,  
aliphatic or alicyclic, functionalized or non-functionalized alkyl radical with 3-36 carbon atoms,  
wherein R' is optionally functionalized with one or more X groups; X is selected from the group  
consisting of an -OH, -OR'', -COOH, -COOR'', -NH<sub>2</sub>, -SO<sub>4</sub>, -F, -Cl, -Br, -I or -CN; and R'' is  
20 selected from the group consisting of a branched or linear hydrocarbon chain with 1 - 12 carbon  
atoms;

the compound has a melting point of less than 100° C;

the cation is a nitrogen-containing cation selected from the group consisting of a  
quaternary ammonium cation, an imidazolium cation, a pyridinium cation, a pyrazolium cation, a  
25 phosphonium and a triazolium cation;

the compound of the Formula 1 is substantially hydrolytically stable in neutral aqueous  
solution (pH = 7) up to 80° C.

<sup>16</sup>  
17 <sup>16</sup> 18) (Previously Amended) The method of claim 17, wherein (R'SO<sub>4</sub>) has an empirical formula  
selected from the group consisting of C<sub>4</sub>H<sub>9</sub>SO<sub>4</sub>, C<sub>8</sub>H<sub>17</sub>SO<sub>4</sub> or C<sub>12</sub>H<sub>25</sub>SO<sub>4</sub>, and; the method  
30 comprises the step of: employing the compound as a solvent, solvent additive, or extraction  
solvent; or employing the compound as a heat carrier, or heat carrier additive; or employing

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18 the compound as a phase transfer catalyst.

19 (Previously Amended) A method of using a compound of the Formula 1 in a process

(cation)(R'SO<sub>4</sub>)

Formula 1

5 comprising the step of: employing the compound as a solvent, solvent additive, or extraction solvent; employing the compound as a heat carrier, or heat carrier additive; or employing the compound as a phase transfer catalyst, wherein:

a) (R'SO<sub>4</sub>) is an alkyl sulfate ester, wherein the alkyl moiety is selected from the group consisting of butyl, octyl, 2-ethylhexyl, and dodecyl;

10 b) the cation is a nitrogen containing cation selected from the group consisting of 1-ethyl-3-methylimidazolium, 1-butyl-3-methylimidazolium butyl, 1-hexyl-3-methylimidazolium, 1-octyl-3-methylimidazolium, 1-decyl-3-methylimidazolium, 1-dodecyl-3-methylimidazolium, 1-butyl-pyridinium, trimethyldecylammonium, trioctylmethylammonium, trimethyldecylammonium, and

15 trihexyltetradecylphosphonium;

c) the compound has a melting point of less than 100° C; and

d) the compound of the Formula 1 is substantially hydrolytically stable in neutral aqueous solution (pH = 7) up to 80° C.

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20 (Previously Amended) The method of claim 18, wherein the process is a reaction catalyzed by a transition metal, and the reaction is a hydroformylation reaction, oligomerization reaction, esterification reaction, isomerization reaction or amide bond-forming reaction.

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21 (Previously Amended) The method of claim 18, wherein the process is a reaction catalyzed by an enzyme or biocatalyst, and the reaction is an oligomerization reaction, C-C bond-forming reaction, esterification reaction, isomerization reaction, or amide bond-forming reaction.

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22 (Previously added) The method of claim 18, wherein the cation is selected from the group consisting of:

a) quaternary ammonium cation with the general formula (NR<sub>1</sub>R<sub>2</sub>R<sub>3</sub>R)<sup>+</sup>;

b) phosphonium cation with the general formula (PR<sub>1</sub>R<sub>2</sub>R<sub>3</sub>R)<sup>+</sup>;

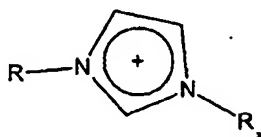
30 c) imidazolium cation with the general formula

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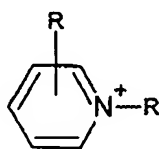
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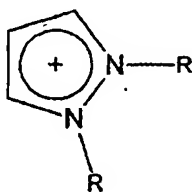
in which the imidazole core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group;

- 5 d) pyridinium cation with the general formula



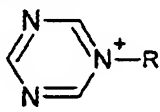
in which the pyridine core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group;

- 10 e) pyrazolium cation with the general formula



in which the pyrazole core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group; and

- 15 f) triazolium cation with the general formula



in which the triazole core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group; wherein

- 20 g) the radicals R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup> are selected independently at each occurrence from the group



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consisting of:

- i) hydrogen;
- ii) linear or branched, saturated or unsaturated, aliphatic or alicyclic alkyl groups with 1 to 20 carbon atoms;
- 5    iii) heteroaryl groups, heteroaryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 3 to 8 carbon atoms in the heteroaryl radical and at least one heteroatom selected from N, O and S which is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl groups and/or halogen atoms;
- 10    iv) aryl, aryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 5 to 12 carbon atoms in the aryl radical, which is optionally substituted with at least one C<sub>1</sub>-C<sub>6</sub> alkyl group and/or a halogen atom; and
- h) the radical R is selected from the group consisting of:
  - i) linear or branched, saturated or unsaturated, aliphatic or alicyclic alkyl groups with 1 to 20 carbon atoms;
  - 15    ii) heteroaryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 3 to 8 carbon atoms in the aryl radical and at least one heteroatom selected from N, O and S, which is optionally substituted with at least one C<sub>1</sub>-C<sub>6</sub> alkyl group and/or halogen atom; and
  - 20    iii) aryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 5 to 12 carbon atoms in the aryl radical, which is optionally substituted with at least one C<sub>1</sub>-C<sub>6</sub> alkyl group and/or halogen atom.